

## **APPENDIX A**

1. In the fabrication of liquid crystal displays (LCDs), a method for forming silicon films with a controlled amount of trace impurities, the method comprising:

forming a target including silicon and a first concentration of a first impurity;

supplying a substrate; and

sputter depositing a film of silicon on the substrate including a second concentration of the first impurity.

2. The method of claim 1 wherein forming a target including silicon and a first concentration of a first impurity includes forming a target with a first impurity selected from the group including transition metals, phosphorous, and germanium.

3. The method of claim 2 wherein forming a target including silicon and a first concentration of a first impurity includes forming a target including a nickel first impurity.

4. The method of claim 3 wherein forming a target including silicon and a first concentration of a first impurity includes forming a target with a first concentration of nickel in the range of 0.01 to 0.5 atomic percent (at %); and,

wherein sputter depositing a film of silicon on the substrate including a second concentration of the first impurity includes depositing a silicon film including a second concentration of nickel in the range of 0.01 to 0.5 at %.

5. The method of claim 4 wherein forming a target including silicon and a first concentration of a first impurity includes forming a target with a first concentration of nickel in the range of 0.05 to 0.2 at %; and,

wherein sputter depositing a film of silicon on the substrate including a second concentration of the first impurity includes depositing a silicon film including a second concentration of nickel in the range of 0.01 to 0.5 at %.

6. (Amended) The method of claim 4 wherein forming a target including silicon and a first concentration of a nickel includes forming the target with an additional third concentration of phosphorous less than  $5 \times 10^{17}$  atoms/cm<sup>3</sup>; and,

wherein sputter depositing a film of silicon on the substrate including a second concentration of nickel includes depositing a silicon film with an additional fourth concentration of phosphorous sufficient to create a first V<sub>th</sub> shift in the silicon film.

7. The method of claim 1 wherein sputter depositing a film of silicon on the substrate including a second concentration of the first impurity includes sputter depositing using a process selected from the group including pulsed and non-pulsed direct current (DC) sputtering.

8. The method of claim 2 wherein forming a target including silicon and a first concentration of a first impurity includes forming a target with a first concentration of germanium in the range of 5 to 30 at %; and,

wherein sputter depositing a film of silicon on the substrate including a second concentration of the first impurity includes depositing a silicon film including a second concentration of germanium in the range of 5 to 30 at %.

9. (Amended) The method of claim 8 wherein forming a target including silicon and a first concentration of a germanium includes forming the target with an additional third concentration of phosphorous less than  $5 \times 10^{17}$  atoms/cm<sup>3</sup>; and,

wherein sputter depositing a film of silicon on the substrate including a second concentration of germanium includes depositing a silicon film with an additional fourth concentration of phosphorous sufficient to create a first V<sub>th</sub> shift in the silicon film.

10. The method of claim 3 further comprising:  
annealing the silicon film including the first impurity of nickel to form a silicide; and,

annealing the silicon film with the nickel silicide to crystallize the silicon film.

11. The method of claim 1 wherein forming a target including silicon and a first concentration of a first impurity includes forming a target of single-crystal silicon; and,

wherein sputter depositing a film of silicon on the substrate including a second concentration of the first impurity includes forming a film of amorphous silicon.

12. In the fabrication of liquid crystal displays (LCDs), a method for depositing silicon films with trace impurities, the method comprising:

supplying a substrate; and  
sputter depositing silicon and a controlled amount of a first impurity on the substrate.

13. The method of claim 12 further comprising:  
forming a target of single-crystal silicon including a first concentration of the first impurity.

14. The method of claim 12 further comprising:  
following the sputter depositing, forming an amorphous silicon film including a second concentration of the first impurity overlying the substrate.

15. The method of claim 13 wherein forming a target of single-crystal silicon including a first concentration of the first impurity includes forming a target with a first impurity selected from the group including transition metals, phosphorous, and germanium.

16. The method of claim 15 wherein forming a target of single-crystal silicon including a first concentration of the first impurity includes forming a target including a nickel first impurity.

17. The method of claim 16 wherein forming a target of single-crystal silicon including a first concentration of the first impurity

includes forming a target with a first concentration of nickel in the range of 0.01 to 0.5 atomic percent (at %); and,

wherein forming an amorphous silicon film including a second concentration of the first impurity includes forming a silicon film including a second concentration of nickel in the range of 0.01 to 0.5 at %.

18. The method of claim 17 wherein forming a target of single-crystal silicon including a first concentration of the first impurity includes forming a target with a first concentration of nickel in the range of 0.05 to 0.2 at %; and,

wherein forming an amorphous silicon film including a second concentration of the first impurity includes forming a silicon film including a second concentration of nickel in the range of 0.01 to 0.5 at %.

19. (Amended) The method of claim 17 wherein forming a target of single-crystal silicon including a first concentration of nickel includes forming a target with an additional third concentration of phosphorous less than  $5 \times 10^{17}$  atoms/cm<sup>3</sup>; and,

wherein forming an amorphous silicon film including a second concentration of nickel includes forming a silicon film with an additional fourth concentration of phosphorous sufficient to create a first  $V_{th}$  shift in the silicon film.

20. The method of claim 12 wherein sputter depositing silicon and a controlled amount of a first impurity on the substrate includes sputter depositing using a process selected from the group including pulsed and non-pulsed direct current (DC) sputtering.

21. The method of claim 15 wherein forming a target of single-crystal silicon including a first concentration of the first impurity includes forming a target with a first concentration of germanium in the range of 5 to 30 at %; and,

wherein forming an amorphous silicon film including a second concentration of the first impurity includes forming a silicon film including a second concentration of germanium in the range of 5 to 30 at %.

22. (Amended) The method of claim 21 wherein forming a target of single-crystal silicon including a first concentration of germanium includes forming a target with an additional third concentration of phosphorous less than  $5 \times 10^{17}$  atoms/cm<sup>3</sup>; and,

wherein forming an amorphous silicon film including a second concentration of germanium includes forming a silicon film with an additional fourth concentration of phosphorous sufficient to create a first  $V_{th}$  shift in the silicon film.

23. The method of claim 16 further comprising:

annealing the silicon film including the nickel first impurity to form a nickel silicide; and,

annealing the silicon film with the nickel silicide to crystallize the silicon film.

24. (added) In the fabrication of liquid crystal displays (LCDs), a method for forming silicon films with a controlled amount of trace impurities, the method comprising:

forming a target including single crystal silicon and a first concentration of nickel in the range of 0.05 to 0.2 at %;  
supplying a substrate;  
sputter depositing a film of amorphous silicon on the substrate including a second concentration of nickel in the range of 0.01 to 0.5 at %.  
annealing the silicon film to form a nickel silicide; and,  
annealing the silicon film with the nickel silicide to crystallize the silicon film.

25. (added) The method of claim 24 wherein forming a target including silicon and a first concentration of a nickel includes forming the target with an additional third concentration of phosphorous less than  $5 \times 10^{17}$  atoms/cm<sup>3</sup>; and,

wherein sputter depositing a film of silicon on the substrate including a second concentration of nickel includes depositing a silicon film with an additional fourth concentration of phosphorous sufficient to create a first  $V_{th}$  shift in the silicon film.